controlled release from a polymer matrix, for example, silicone rubber, as set forth in U.S. Patent Nos. 5,837,313; 6,099,562 and 6,120,536 to Ding et al.

In one exemplary embodiment, heparin may be immobilized onto the stent as briefly described below. The surface onto which the heparin is to be affixed is cleaned with ammonium peroxidisulfate. Once cleaned, alternating layers of polyethylenimine and dextran sulfate are deposited thereon. Preferably, four layers of the polyethylenimine and dextran sulfate are deposited with a final layer of polyethylenimine. Aldehyde-end terminated heparin is then immobilized to this final layer and stabilized with sodium cyanoborohydride. This process is set forth in U.S. Patent Nos. 4,613,665; 4,810,784 to Larm and 5,049,403 to Larm et al.

Unlike rapamycin, heparin acts on circulating proteins in the blood and heparin need only make contact with blood to be effective. Accordingly, if used in conjunction with a medical device, such as a stent, it would preferably be only on the side that comes into contact with the blood. For example, if heparin were to be administered via a stent, it would only have to be on the inner surface of the stent to be effective.

In an exemplary embodiment of the invention, a stent may be utilized in combination with rapamycin and heparin to treat vascular disease. In this exemplary embodiment, the heparin is immobilized to the inner surface of the stent so that it is in contact with the blood and the rapamycin is immobilized to the outer surface of the stent so that it is in contact with the surrounding tissue. Figure 7 illustrates a cross-section of a band 102 of the stent 100 illustrated in Figure 1. As illustrated, the band 102 is coated with heparin 108 on its inner surface 110 and with rapamycin 112 on its outer surface 114.

In an alternate exemplary embodiment, the stent may comprise a heparin layer immobilized on its inner surface, and rapamycin and heparin on its outer surface. Utilizing current coating techniques, heparin tends to form a stronger bond with the surface it is immobilized to then does rapamycin.